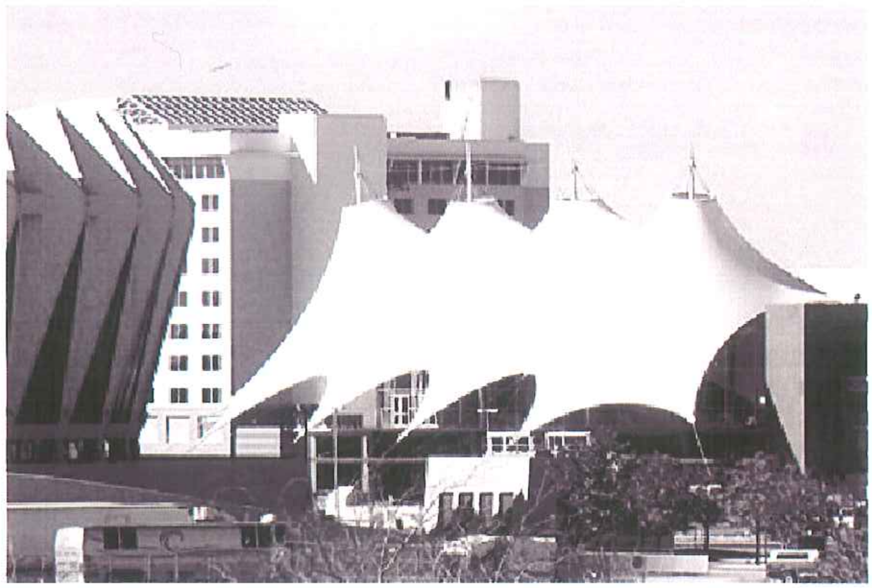
REPORT



# SSES PLAN

## CITY OF HAMPTON
## DEPARTMENT OF PUBLIC WORKS
## WASTEWATER OPERATIONS DIVISION
## HAMPTON, VIRGINIA

Revised June 2009

# TABLE OF CONTENTS



# TABLE OF FIGURES

# 1.0 INTRODUCTION

On September 26, 2007, the Virginia Department of Environmental Quality (DEQ), State Water Control Board, issued a Special Order of Consent (SOC) to the Hampton Roads Sanitation District (HRSD), the cities of Chesapeake, Hampton, Newport News, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg; the counties of Gloucester, Isle of Wight, and York; the James City Service Authority; and the town of Smithfield for the purpose of resolving certain alleged violations of environmental laws and regulations. The purpose of the SOC and its associated Regional Technical Standards (RTS) was to reduce the occurrence of sanitary sewer overflows (SSOs) in the Regional Sanitary Sewer System.

## 1.1 Scope

To comply with the terms of the Regional SOC, the City of Hampton is required to perform the following task:

> *SSES Plan: By the last day of the month that is 15 months after the effective date of this order, complete and submit to the DEQ for approval, a plan for conducting an SSES of the City's collection system. The plan shall conform to the Regional Technical Standards in Attachment 1. Provided that DEQ is involved in the development of the SSES Plan, upon receipt of a completed Plan, DEQ anticipates review and approval can be accomplished within 60 days. The approved plan shall become a requirement of this Order and the SSES shall be implemented in accordance with the approved schedule.*

According to the Regional Technical Standards as incorporated in the Regional SOC:

> *An SSES Plan shall be developed to meet the following objectives:*
> - *Identify and prioritize basins for investigation*
> - *Establish baseline estimates of I/I*
> - *Select the detailed approach to provide sufficient information for condition assessment activities including hydraulic, corrosion and structural investigation*
> - *Coordinate improvements to records and mapping that may be needed*
> - *Establish a schedule of activities*

Additional guidance for the SSES Plan was received from DEQ in a letter dated May 8, 2009.

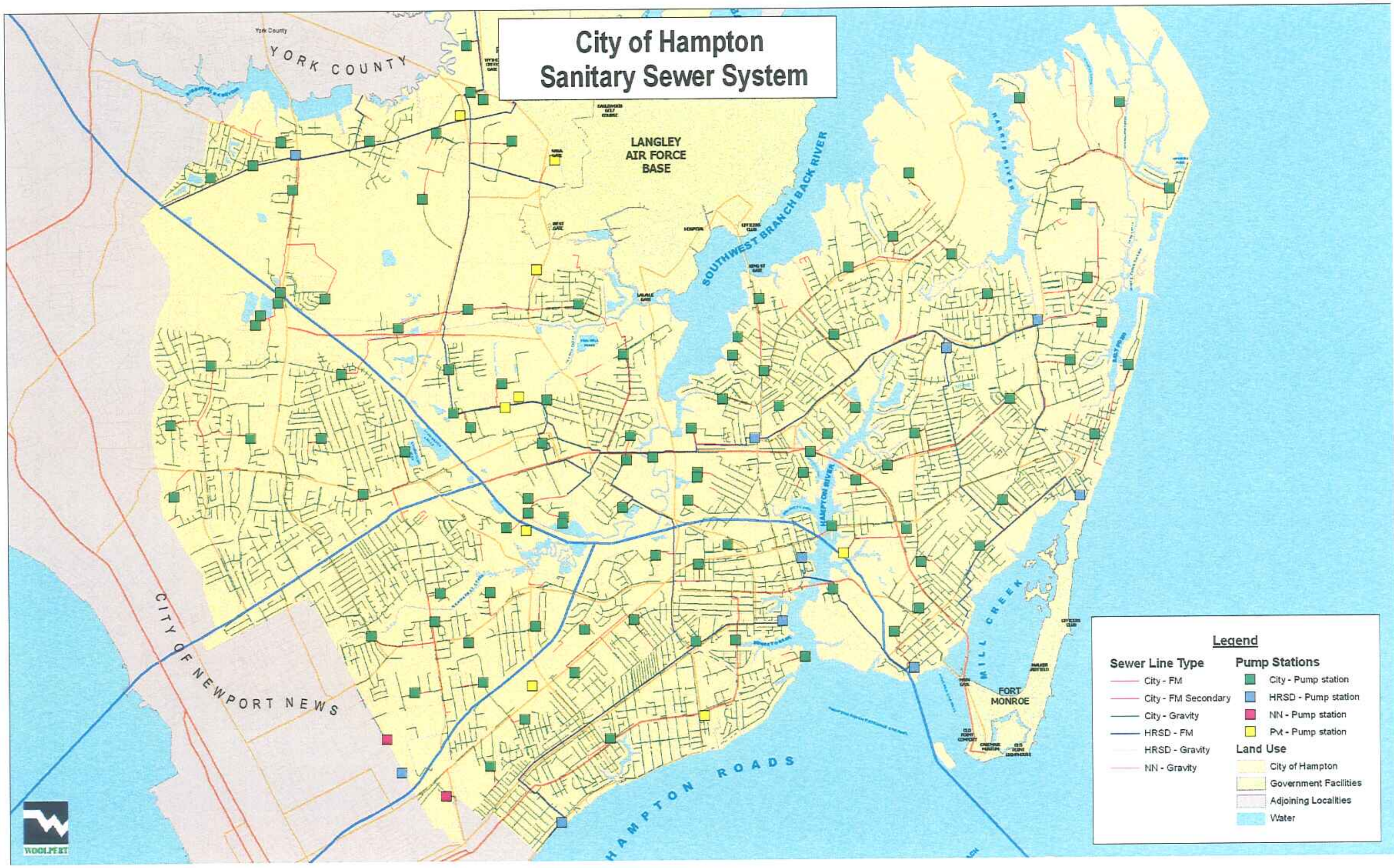
This report documents how the City of Hampton has developed its SSES plan to comply with its Regional SOC.

## 1.2 Background

The City of Hampton Department of Public Works provides sanitary sewer collection services to 145,000 people via 46,000 accounts, across its approximately 136.2 square mile service area. The City owns more than 430 miles of gravity pipelines, ranging in size from 4 inches to 21 inches in diameter; approximately 11,055 access structures; 104 pump stations; and approximately 47 miles of force mains. All sewage collected is pump to the Hampton Roads Sanitation District (HRSD) for treatment.

The City of Hampton's sewer system is depicted in Figure 1.1 below. (Please note that larger copies of this figure and all the figures in the document can be found in Appendix A.)

## Figure 1.1 Hampton Sanitary Sewer System



## 1.3 Documents and Informational Sources

Woolpert reviewed numerous document and information sources in the preparation of this document.

These sources included:

- 2007 Regional Special Order of Consent,
- 2002 Consent Order,
- 2005-2009 Waste Water Strategic Plan,
- City of Hampton's 2007 Flow Monitoring Plan,
- City of Hampton's GIS,
- HRSD SSES Plan, March 2009
- Newport News SSES Plan, December 31, 2008,
- Virginia Department of Environmental Quality Website,
- U.S. Census website,
- City of Hampton flow meter data,
- City of Hampton GBA data,
- Newport News Waterworks distribution data, and
- National Climatic Data Center.

Woolpert also conducted interviews with Jason Mitchell, Wastewater Operations Manager, Hampton Department of Public Works, Barry Dobbins, Collection Systems Manager, Hampton Department of Public Works, and McCord Newsome, Wastewater Engineer, Hampton Department of Public Works, Maria Nold and Kim Butler, Virginia Department of Environmental Quality, Steve Williams, Steve Land, Joyce Heffington, Vince Urbano, Newport News Public Works.

# 2.0 SSES Basin Identification

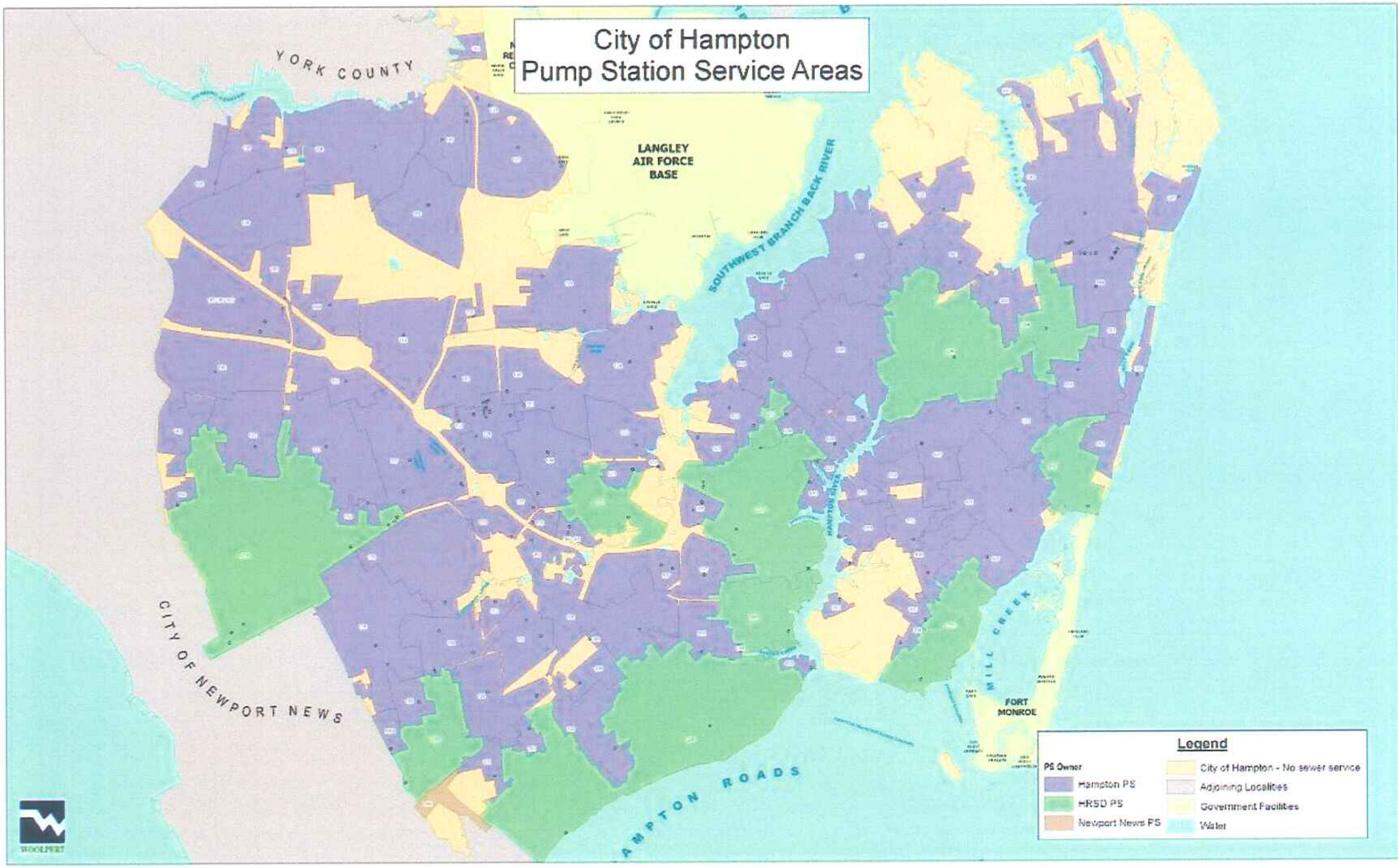
The City of Hampton has divided its collection system into service areas. There are 102 city-owned pump stations in the City of Hampton's service area due to the flat topography found in coastal Virginia. Additionally there also are 12 pump stations operated by other entities; 10 by HRSD and 2 by Newport News. The city-owned pump stations collect flow from 1,607,320 linear feet of sewer main, which is approximately 68.3% of Hampton's collection system, HRSD pump stations from 733,376 linear feet (31.2%) and Newport News pump stations 11,284 linear feet(0.5%). Each pump station service area contains a gravity sewer network located upstream of a pump station. These pump station service areas are contained in the City's GIS where the City is geo-referencing all prior and future Operations and Maintenance (O&M) activities, SSOs, flow monitoring, rehabilitation, replacement and other related activities and information. This organization of information helps the City keep track of all the activities in each pump station service area in an efficient manner. The City's GIS has been a significant contributor to this project.

All facilities that serve Hampton were evaluated as part of this SSES Plan including those operated by other organizations. The pump stations operated by the City of Hampton are designated by numbers less than 200. The pump stations operated by HRSD are designated by numbers greater than 200. Newport News pump stations are designated by "NN." (Only small portions of the pump station service areas that are served by Newport News pump stations are within the Hampton service area. Therefore, these pump stations were not included in the evaluation to determine SSES basins. They will, however, be included in the SSES activities.) All of these pump stations pump sewage to Hampton Roads Sanitation District facilities for treatment.

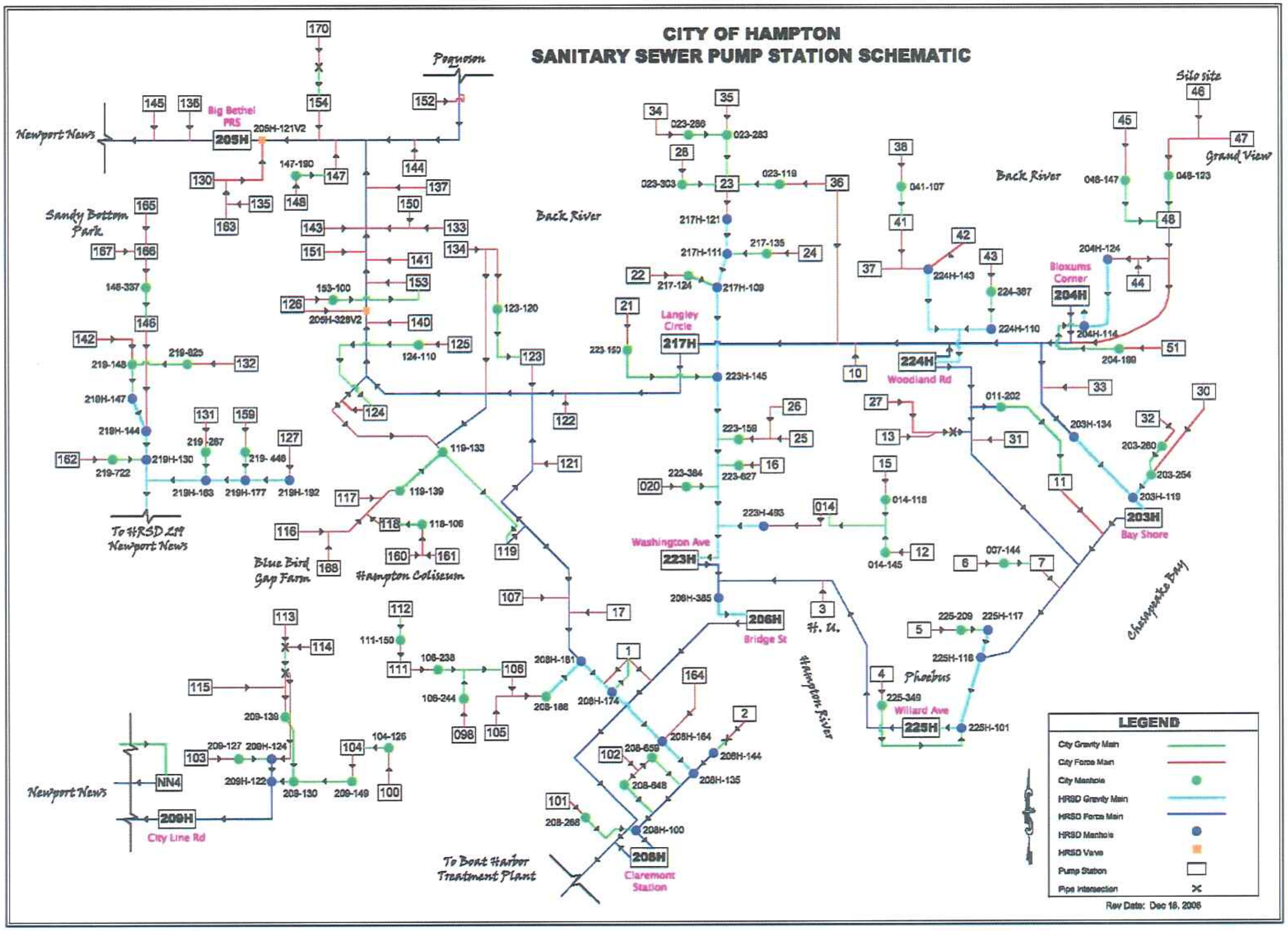
Hampton requested and reviewed flow data from HRSD for the ten pump stations in the Hampton service area for this report. Additionally, the data for those pump station service areas contained in the March 2009 HRSD SSES Plan is included in this plan. Hampton reviewed Newport News' December 2008 SSES Plan. The data for the two Newport News pump station service areas in the Hampton service area is also included in this plan.

Figure 2.1, below, shows the locations of Hampton's pump station service areas and the entities that operate those pump stations. The connectivity of those pump stations is shown in Figure 2.2.

## Figure 2.1 Hampton Pump Station Service Areas



## Figure 2.2 Hampton Pump Station Schematic



As indicated in the 2007 Flow Monitoring Plan, the city-owned pump station service areas were grouped into 59 basins for flow monitoring and SSES plan development. The basins were delineated by determining the point where the City's ownership ended and HRSD's began. Everything connected upstream of that point was considered part of the basin. The basins designated in the 2007 Flow Monitoring Plan were reviewed for this SSES Plan and basin numbers were assigned to facilitate the SSES basin identification process. It should be noted that a large portion of Hampton's collection system (31.2 %) is directly connected to HRSD gravity main through hundreds of gravity connections. These connections and the City's gravity sewer upstream have been added to HRSD pump station service areas. This increases the number of basins by the ten HRSD areas. For the development of the SSES plan, the original 59 basins plus the 10 HRSD basins and the 2 Newport News basins were further divided into 114 service areas. For the purposes of this document, these 114 service areas are referred to as basins throughout as indicated on Table 2.8

The Regional Technical Standards requires a two step evaluation process of the City's collection system to develop the SSES plan. The first step is an initial screening process based upon the following criteria:

- Basins with unresolved wet weather SSOs, except where SSOs have only resulted during rainfall conditions in excess of a ten-year, 24 hour rainfall recurrence interval
- Basins with unresolved wet weather SSOs caused by infrastructure defects (pipe sags, offset joints, broken pipe, etc.)

The second step is to evaluate the excessive flows that a basin may receive during wet weather events based on the following criteria:

- Basins exceeding an actual peak flow of 775 gallons per day per equivalent residential unit plus three times commercial water consumption plus actual major industrial flows, where this peak flow is estimated to occur during rainfall conditions up to a ten-year, 24 hour rainfall occurrence interval
- Basins served by pump stations that exhibit excessive pump run time

## 2.1 Unresolved SSOs

Unresolved SSOs are defined by the RTS as "any SSO for which the underlying cause has not been resolved so as to prevent future reoccurrences at that location from that cause."

Basins with unresolved wet weather SSOs are considered SSES basins except where SSOs are the result of rainfall conditions in excess of a ten-year, 24 hour recurrence interval. For this area, a ten-year storm is 5.53 inches of rainfall in a twenty-four hour period.

SSO data from October 2000 through July 2008 was reviewed to determine the number of unresolved wet weather SSOs. A total of nine unresolved wet weather overflows were identified and are listed in Table 2.1 below.

**Table 2.1: Unresolved Wet Weather SSOs**

| Date | Service Area | Address | Type | Source | Primary Cause | Rainfall Amount (in.)* |
|---|---|---|---|---|---|---|
| 10/29/2003 | 225 | Hope | Capacity-Weather Related | Gravity Main | Storm Related | 1.83 |
| 11/22/2006 | 225 | Chamberlin | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 206 | Queen | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 206 | Armistead | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 208 | 303 Congress | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 208 | 4009 Catesby Jones | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 225 | 26 Booker | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 223 | 3630 Monroe | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |
| 11/22/2006 | 208 | Victoria | Capacity-Weather Related | Gravity Main | Storm Related | 1.21 |

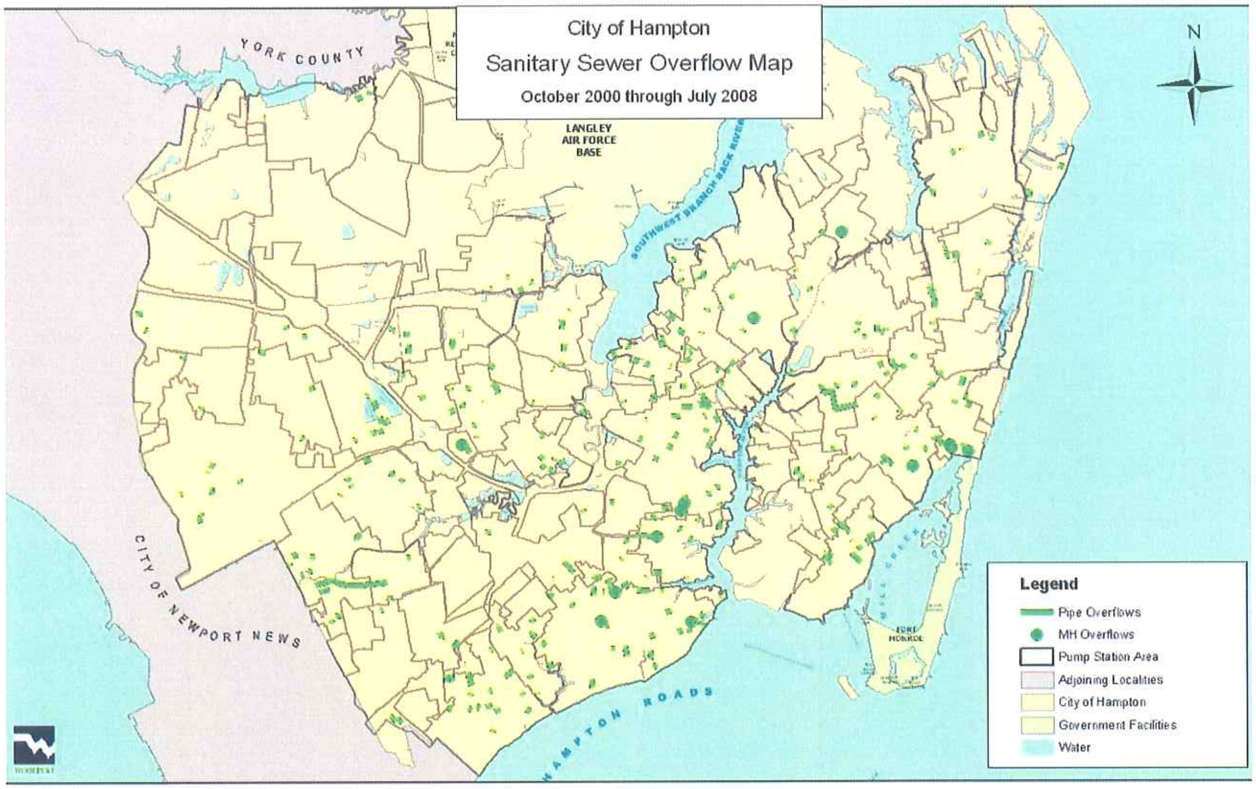
* Historical rainfall amounts determined from NOAA data.

In addition, HRSD's SSES plan reports unresolved wet weather overflows in Service Area 206.

The unresolved wet weather SSOs in basins 206, 208, 223 and 225 qualify those areas as SSES basins.

Figure 2.3 shows the locations all reported SSOs from October 2000 until July 2008.

Figure 2.3 Hampton SSOs 2000- 2008




Additionally, the City of Hampton has reported to HRSD seven Locality Overflow Points (LOPs). These are known locations of overflows that occur within the City of Hampton's service area, directly upstream from HRSD gravity sewer lines. These overflows occur during relative small storms and appear to be influenced somewhat by HRSD's system. For the purpose of this report, these LOPs are considered to be locations of unresolved SSOs. The most recent letter that the City has sent to the Virginia Department of Environmental Quality regarding LOPs is located in Appendix B. The seven LOPs are listed in Table 2.2 below:

**Table 2.2: Locality Overflow Points (LOPs)**

| LOP Address | Service Area |
|---|---|
| Foxhill at Old Buckroe | 204 |
| Queen at Eaton | 206 |
| Congress at Catsby Jones | 208 |
| Victoria at Ivy Home | 208 |
| Kings at Macalva | 217 |
| Mercury at Monroe | 223* |
| Hope at Chamberlain | 225 |

* Hampton has completed further investigation into the overflows at Basin 223. The issue was resolved and this basin is no longer considered an LOP.

Therefore, based upon the data available for unresolved SSOs and the LOPs, basins 204, 206, 208, 217, 223 and 225 are considered SSES basins.

## 2.2 Excessive Peak Flow Analysis

Excessive peak flows are defined by the regional technical standards as "Basins exceeding an actual peak flow of 775 gallons per day per equivalent residential unit (ERU) plus 3 times the commercial water consumption plus actual major industrial flows, where this peak flow is estimated to occur during rainfall conditions up to a ten-year, 24 hour rainfall recurrence interval." Although the RTS does not specifically state this to be a peak hour flow, Section 3 Flow Monitoring refers to the peak one hour flow as being critical for identifying SSES basins. Therefore, for the purposes of this study the flow comparisons will be made on a peak hour basis. All private and SSES excluded flows that contributed to a metered location were included in the peak flow calculation.

### 2.2.1 Results of Flow Monitoring Program

The City of Hampton's Flow Monitoring Plan was developed based on the requirements of the RTS and submitted in December 2007. Several different methods and meters were included to measure flows. The original FMP did not include HRSD or Newport News basins. The original Flow Monitoring Plan stated that data would be collected via 52 permanent magnetic flow meters and 28 temporary area-velocity meters. However Hampton actually installed 15 magnetic flow meters with Telog data recorders, 44 magnetic flow meters on the City's SCADA system, and 33 temporary area-velocity meters. In 12 pump stations, more than one meter type was installed. Additional area-velocity meters were installed at some pump stations with magnetic flow meters in order to increase the data collection frequency for modeling purposes.

Four of the temporary area-velocity meters were removed due to low flow conditions before the end of the monitoring period. These flow monitoring methods are shown in Table 2.3 below:

**Table 2.3: Hampton Flow Monitoring Program Data Sources**

| Data Collected | Data Source | Data Collection Interval | Number of Units Proposed | Number of Units Installed[1] |
|---|---|---|---|---|
| Gravity Sewer Flow | Temporary Area-Velocity Meters | 15 minute and 5 minute | 28 | 34[2] |
| Force Main Flows | Mag Meters w/SCADA System | Daily (24-hour) Totals | 52 | 44 |
| Force Main Flows | Mag Meters w/Telogs | 15 minute and 5 minute | | 15 |

[1] Some pump stations had multiple monitors installed

[2] Four temporary area velocity meters were removed early during the monitoring period due to low flows leaving thirty for the remainder.

The 2007 Flow Monitoring Plan stated that approximately 97% of the Hampton owned pump stations would be monitored under that plan including 12 pump stations with indirect flow monitoring or alternate methodologies for flow measurement. These 12 pump stations have extremely low flows. It was anticipated that flow monitors would not be able to accurately record data from these stations. Therefore, data for these pump stations would be manually collected during the Condition Assessment Phase of the project.

Without including those basins with indirect flow monitoring, approximately 77% of the pump stations were planned to be monitored in the 2007 Plan. The number of meters actually installed was higher than originally stated in the FMP. However, due the installation of multiple types of meters in the same pump station, the monitored percentage remained the same at 77%.

### 2.2.2 Basin Associations

To complete the excessive peak flow analysis, it was determined that only the data from the area-velocity meters was suitable for estimating the peak flow threshold for each basin. Therefore, all basins without flow meters and basins where data was not suitable for monitoring were associated to basins with area velocity meters and similar characteristics. Table 2.4 below shows these basins and their associated basins. Seven of the metered locations experienced surcharged conditions during the flow monitoring period, noted in the table below, and therefore were not associated to other basins. These basins were automatically identified as SSES basins.

**Table 2.4: Basin Associations**

| Meter Location | Associated Basins |
|---|---|
| 010 | Surcharged -None |
| 012 | 006, 013, 014, 107 |
| 015 | Surcharged -None |
| 021 | 004, 005, 015, 016, 017, 020, 101, 217 |
| 023 | 011, 022, 023, 027, 031, 036, 102, 113, 115, 206, 208, 219, 223, 224 |
| 024 | Surcharged -None |
| 026 | 032 |
| 035 | 002, 025, 034 |
| 037 | 001, 105, 106, 111, 114, 134 |
| 042 | 041, 043 |
| 044 | 033, 204, 225 |
| 047 | 030, 046 |
| 048 | 007, 123, 203 |
| 051 | 028, 045 |
| 118 | 160, 161 |
| 121 | 003, 112, 119, 141 |
| 125 | 127, 131, 133 |
| 126 | 116, 117, 124, 137 |
| 130 | 100, 135, 163 |
| 136 | Surcharged -None |
| 140 | Surcharged -None |
| 142 | 132 |
| 143 | 103, 104, 164, 209 |
| 145 | Surcharged -None |
| 146 | |
| 151 | |
| 147 | 148 |
| 154 | Surcharged -None |
| 159 | Surcharged -None |
| 162 | 038, 098, 144, 150, 152, 153, 170 |

### 2.2.3 Peak Flow Threshold Calculations

Residential flows were estimated by multiplying the actual residential connections by 775 gallons per day. Data on the number of residential units per service area were obtained from GIS information provided by the City, review of aerial maps, internet research and windshield surveys. Each of the apartments, condominiums, townhomes, mobile homes and single family residential properties was counted as one residential connection. Actual commercial and industrial average annual daily flow data was obtained from Newport News Water Works. At the time of this report, only one year of water consumption data was available for use.

The peak flow threshold for each service area was calculated from the estimated residential flow plus three times actual commercial and industrial water use to determine basins with excessive peak hour flows. The calculation described above represents the expected peak one-hour flow threshold for each basin.

The worksheet for these calculations can be found in Appendix C.

### 2.2.4 SSES Basin Determination

For the analysis and determination of SSES basins, flow monitoring data was collected from the City's network of flow monitoring sites. Flow data was collected from permanent and temporary monitoring stations for the Hampton sewer basins. In addition, data was reviewed from HRSD for the ten basins that are served by HRSD pump stations. (The Newport News pump stations basins were not included in this review, since the majority of those basins are located outside of Hampton.) The rain event that occurred September 25 - 26, 2008 was selected to be the wet weather event for this analysis because 14 of 16 rain gauges captured at least 3.36 inches of rainfall (greater than the one-year event of 2.95 inches) and eleven exceeded 3.5 inches which is nearly equivalent to the two-year event. It should be noted that there were no SSOs reported during this rain event. This rain event meets the RTS requirements for capturing a one-year storm event during the flow monitoring period.

Table 2.5 shows the individual storms and the accumulated depths recorded by each rain gauge. The storms highlighted in blue exceed one inch of accumulation which demonstrate meeting the RTS requirements of capturing three qualifying rain events for flow monitoring.

**Table 2.5 Storm Events and Rainfall Depths**

| Storm Event | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Date | 4/21/08 | 8/10/08 | 8/15/08 | 9/5/08 | 9/10/08 | 9/25/08 | 10/1/08 |
| RG-004 | 0.81 | 1.63 | 1.18 | 0.56 | 0.37 | 2.90 | 0.46 |
| RG-011 | 1.96 | 1.47 | 1.55 | 0.95 | 1.77 | 3.60 | 0.87 |
| RG-017 | 1.14 | 0.08 | 0.04 | 0.12 | 0.08 | 4.30 | 1.37 |
| RG-023 | 2.05 | 1.26 | 1.16 | 0.95 | 0.31 | 3.93 | 1.01 |
| RG-031 | 1.91 | 1.41 | 1.66 | 0.84 | 1.26 | 3.90 | 0.81 |
| RG-036 | 0.90 | 1.05 | 1.06 | 0.87 | 0.32 | 3.73 | 0.85 |
| RG-045 | 1.45 | 0.72 | 0.59 | 0.84 | 1.28 | 2.62 | 0.49 |
| RG-047 | 1.75 | 0.83 | 0.94 | 0.86 | 1.52 | 3.09 | 0.69 |
| RG-102 | 0.00 | 2.35 | 1.30 | 1.05 | 0.07 | 3.92 | 1.03 |
| RG-103 | 2.09 | 1.44 | 0.65 | 1.28 | 0.08 | 3.64 | 0.98 |
| RG-106 | 1.83 | 1.78 | 1.28 | 1.02 | 0.10 | 3.81 | 1.11 |

| Storm Event | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Date | 4/21/08 | 8/10/08 | 8/15/08 | 9/5/08 | 9/10/08 | 9/25/08 | 10/1/08 |
| RG-124 | 2.28 | 1.31 | 1.32 | 1.12 | 0.08 | 3.65 | 1.11 |
| RG-146 | 1.89 | 0.77 | 1.08 | 0.76 | 0.12 | 3.95 | 0.79 |
| RG-147 | 1.77 | 0.66 | 0.14 | 1.17 | 0.11 | 3.36 | 0.60 |
| RG-153 | 2.00 | 0.90 | 1.05 | 1.17 | 0.09 | 3.40 | 0.62 |
| RG-159 | | 1.42 | 1.34 | 0.90 | 0.04 | 3.45 | 0.53 |
| RG-162 | | 1.53 | 0.74 | 1.50 | 0.06 | 4.67 | 0.72 |

### 2.2.5 RTS Compliant Peak Flow Projection Analysis

This analysis based upon the estimate of the peak hour flow of a storm event that occurs with a ten year recurrence interval was performed as required by the RTS. The projected peak hour flow is compared to the peak hour flow threshold of each basin. Basins where this projected peak flow is greater than the peak flow threshold are identified as SSES basins. The method chosen to estimate the ten-year peak flow recurrence interval is the RTK Unit Hydrograph method using the EPA – XP SWMM5 computer program.

The RTK Unit Hydrograph method is limited to basins with satisfactory data from the temporary area velocity meters because the program requires gravity flow and 15 minute or 5 minute data measurements to complete the ten-year peak flow projection. The peak flow projection is dependent on calibration to a measured peak wet weather flow. Before the end of the monitoring period, four of the temporary area-velocity meters were removed due to extremely low flow conditions that prevented the meters from recording any data. Therefore, the original 34 temporary area-velocity meters is reduced to 30 temporary area-velocity meters for estimating the ten-year peak hour flow. These 30 meters and the basins they are monitoring are indicated in the Table 2.4 above:

The data from the 30 remaining area-velocity meters was analyzed to project the expected peak flow from a ten-year storm. This review indicated that seven of the meters (basins 24, 130, 136, 140, 145, 154, and 159) demonstrated backwater or surcharged conditions during the rain event that occurred September 25 - 26, 2008. The ten-year peak hour flows cannot be projected under backwater conditions because the flow data does not show a spike in flows due to storm events. Without the wet weather hydrograph, the program is not able to project to the ten-year peak hour flow. This means there are only 23 temporary velocity meters available to estimate the ten-year peak flow projection for the city's entire collection system.

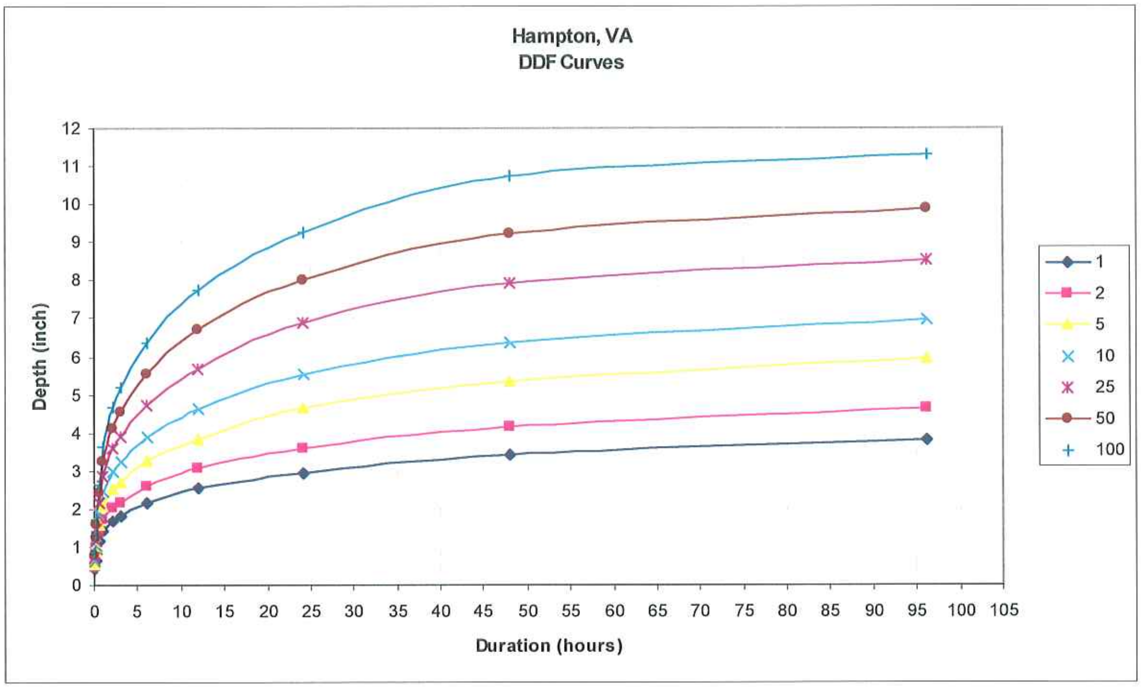
The gravity sewer flow monitoring data for these remaining 23 meters was analyzed using the RTK method in the SHAPE program provided by CDM. The flow monitoring program captured three qualifying rain events; however since the September 25-26, 2008 storm event was nearly a two-year event; it was chosen as the primary rain event for the RTK analysis. The RTK analysis is most accurate when done for a single rain event. Therefore, it was not done for the other two qualifying rain events for the following reasons:

1. The two-year rain event will be most accurate event to estimate the flows for a ten-year event because the other events were less than a one-year event. The more distance between the actual event and the projected event; the less confidence the projected event will estimate accurate flows. This situation is further explained below.

2. Since seven of the meters surcharged during the two-year event, then conducting a RTK analysis on these meters with RTK values from other rain events would generate inaccurate results. The RTK method will project a future 10 year peak hour flow, but since these metered sites surcharge during a two-year event, the accuracy of the projection would be questioned. These seven areas have automatically qualified as SSES basins.

Figure 2.4 shows the depth-duration-frequency (DDF) curves for the City of Hampton used to determine the size of a storm event.

**Figure 2.4 Hampton DDF Curves**




The SHAPE program isolates the dry weather flow quantities and diurnal patterns, and then estimates RTK parameters for a particular rain event are developed for each metered area. These parameters are then input in the EPA – XP SWMM5 program to estimate the peak hour flows that would be expected from the ten-year, 24-hour, SCS type II storm. This peak hour flow was then divided by the inch-diameter-miles (IDM) of the city's gravity collection system upstream of the metered location to create a unit peak hour flow per IDM. This unit peak hour flow per IDM was then multiplied by the IDM of each the basins that are associated to the metered basin listed in Table 2.4. This allows a projected ten-year peak hour flow be estimated for all non-metered basins in the city's system.

The projected ten-year peak hour flow for all basins was then compared to the peak flow threshold for all basins to identify the areas that qualify as SSES areas. These areas are identified in the Summary Table Section 2.5.

## 2.3 Pump Station Run time

Pump station run times were analyzed for all city pump stations that had run time data. All of Hampton's pump stations are duplex stations, containing two pumps. For duplex pump stations, excessive pump station run time occurs when the combined pump station run time exceeds an average of 24 hours per day per pump with one pump out of service during wet weather/peak flow conditions. Initially, pump station run time data was only available for pump stations monitored by Hampton's SCADA system. However, after clarification was received from DEQ in May 2009, pump station run times for the many of the remaining pump stations have since been collected ,analyzed and included in this report. The remaining pump station run times will be collected during the condition assessment phase.

Pump station run time was evaluated during two separate storm events, September 25, 2008 and May 17, 2009. The September 25, 2008 storm was greater than a one-year storm and the May 17, 2009 storm was smaller than a one-year storm but experienced rainfall greater than 1.5 inches as permitted in the May 8, 2009 letter from DEQ. Rainfall amounts ranging from 1.49 -2.06 inches were experienced on May 17th.

Table 2.6 below shows these pump stations and the pump run times recorded during the September 25, 2008 and May 17, 2009 rain events. The hours highlighted in red indicate excessive pump run times. These run times have also been included in Table 2.8.

**Table 2.6: Pump Station Run Times**

| Basin | Pump Run Time 9/25-26/08 Rain Event (hours) | Pump Run Time 5/17/09 Rain Event (Hours) | Meter Type | Downstream Connection |
|---|---|---|---|---|
| 1 | 5.1 | | Magnetic flow | HRSD – Force Main |
| 2 | | 10.8 | | COH – Gravity Sewer |
| 3 | 12.4 | | Magnetic flow | HRSD – Force Main |
| 4 | 3.2 | | Magnetic flow | COH – Gravity Sewer |
| 5 | 3.7 | | Magnetic flow | COH – Gravity Sewer |
| 6 | 4.4 | | Magnetic flow | COH – Gravity Sewer |
| 7 | 10.7 | | Magnetic flow | HRSD – Force Main |
| 11 | 10 | | Magnetic flow | HRSD – Force Main |
| 13 | 4.9 | | Magnetic flow | HRSD – Force Main |
| 14 | 9.3 | | Magnetic flow | HRSD – Gravity Sewer |
| 15 | | 4.1 | Area-Velocity | COH – Gravity Sewer |
| 16 | 4.1 | | Magnetic flow | COH – Gravity Sewer |
| 17 | 5.8 | | Magnetic flow | HRSD – Force Main |
| 20 | | 3.1 | | COH – Gravity Sewer |
| 22 | | 12.3 | | COH – Gravity Sewer |
| 23 | 5.9 | | Area-Velocity | HRSD – Force Main |
| 27 | 8.1 | | Magnetic flow | HRSD – Force Main |
| 28 | 2.1 | | Magnetic Flow | COH – Gravity Sewer |
| 30 | 5.0 | | Magnetic flow | COH – Gravity Sewer |
| 31 | 7.4 | | Magnetic flow | HRSD – Force Main |
| 32 | **26.70** | | Magnetic Flow | COH - Gravity |
| 33 | 4.9 | | Magnetic flow | HRSD – Force Main |
| 34 | 2.6 | | Magnetic flow | COH - Gravity |
| 35 | | 5.9 | Area-Velocity | COH – Gravity Sewer |

| Basin | Pump Run Time 9/25-26/08 Rain Event (hours) | Pump Run Time 5/17/09 Rain Event (Hours) | Meter Type | Downstream Connection |
|---|---|---|---|---|
| 36 | 8.5 | | Magnetic flow | HRSD – Force Main |
| 37 | | 9.8 | Area-Velocity | HRSD – Gravity Sewer |
| 41 | 6.9 | | Magnetic flow | HRSD – Gravity Sewer |
| 42 | | 5.6 | Area-Velocity | HRSD – Gravity Sewer |
| 43 | 5.0 | | Magnetic flow | COH – Gravity Sewer |
| 44 | | 4.10 | Area-Velocity | HRSD – Force Main |
| 45 | 14.3 | | Magnetic flow | COH – Gravity Sewer |
| 47 | 6.2 | | Area-Velocity | COH – Gravity Sewer |
| 51 | 4.4 | | Area-Velocity | COH – Gravity Sewer |
| 100 | 10.1 | | Magnetic flow | COH – Gravity Sewer |
| 101 | 5.2 | | Magnetic flow | COH – Gravity Sewer |
| 102 | 10.3 | | Magnetic flow | COH – Gravity Sewer |
| 103 | 3.0 | | Magnetic flow | COH – Gravity Sewer |
| 104 | 8.4 | | Magnetic flow | COH – Gravity Sewer |
| 105 | 8.4 | | Magnetic flow | COH – Gravity Sewer |
| 106 | 8.0 | | Magnetic flow | COH – Gravity Sewer |
| 107 | 16.5 | | Magnetic flow | HRSD – Force Main |
| 111 | 4.0 | | Magnetic flow | COH – Gravity Sewer |
| 112 | 2.1 | | Magnetic flow | COH – Gravity Sewer |
| 113 | 6.6 | | Magnetic flow | HRSD – Gravity Sewer |
| 114 | 10.2 | | Magnetic flow | HRSD – Gravity Sewer |
| 115 | 13.3 | | Magnetic flow | COH – Gravity Sewer |
| 116 | 10.0 | | Magnetic flow | COH – Gravity Sewer |
| 117 | 7.7 | | Magnetic flow | COH – Gravity Sewer |
| 118 | 3.7 | | Area-Velocity; Magnetic | COH – Gravity Sewer |
| 123 | 8.1 | | Magnetic flow | HRSD – Force Main |
| 124 | 6.5 | | Magnetic flow | HRSD – Force Main |
| 127 | 15.2 | | Magnetic flow | COH – Gravity Sewer |
| 131 | 7.3 | | Magnetic flow | COH – Gravity Sewer |
| 132 | 6.4 | | Magnetic flow | COH – Gravity Sewer |
| 133 | | **25.2** | Magnetic flow | HRSD – Force Main |
| 134 | | **30.1** | Magnetic flow | HRSD – Force Main |
| 135 | 20.5 | | Magnetic flow | HRSD – Force Main |
| 137 | 4.1 | | Magnetic flow | HRSD – Force Main |
| 140 | | 5.4 | Area-Velocity; Magnetic | HRSD – Force Main |
| 141 | 5.6 | | Magnetic flow | HRSD – Force Main |
| 144 | 3.87 | | Magnetic flow | HRSD – Force Main |
| 146 | 8.6 | | Area-Velocity | HRSD – Gravity Sewer |
| 147 | 4.64 | | Area-Velocity; Magnetic | HRSD – Force Main |
| 148 | 1.1 | | Magnetic flow | COH – Gravity Sewer |
| 151 | | 14.4 | Area-Velocity; Magnetic | HRSD – Force Main |
| 153 | 5.6 | | Magnetic flow | HRSD – Force Main |

| Basin | Pump Run Time 9/25-26/08 Rain Event (hours) | Pump Run Time 5/17/09 Rain Event (Hours) | Meter Type | Downstream Connection |
|---|---|---|---|---|
| 159 | 14.7 | | Area-Velocity; Magnetic | HRSD – Force Main |
| 162 | 1.2 | | Area-Velocity; Magnetic | COH – Gravity Sewer |
| 163 | | 1.40 | None | COH- Force Main |

Additionally, the HRSD SSES Report indicated that HRSD pump stations 217, 219 and 225 also exhibited excessive pump run times. Specific run times for HRSD pump stations that did not exhibit excessive pump station run time were not included in the HRSD SSES Report. The Newport News SSES Report indicated that pump station NN exhibited excessive pump station run time but did not include run times for those pump stations that did not exhibit excessive pump run times. Hampton's pump station basins without pump station run time data have been added as SSES areas as required by the May 8, 2009 letter from DEQ and are listed in the Summary table in Section 2.5. Pump station run times will be developed during the condition assessment phase during a minimum 1.5 inch rainfall event in a 24 hour period.

## 2.4 Exclusions

The regional technical standards allow for some small basin and system types to be excluded from SSES activities:

- Vacuum systems,
- Basins associated with small pump stations, and
- Low pressure force mains.

Vacuum systems are excluded from SSES activities. There are no municipal vacuum systems with the Hampton System.

Basins associated with small pump stations, less than 25 gpm at design pressure, are excluded from SSES activities. There is only small pump station in Hampton's system, pump station 122, which meets this criterion.

Low pressure force main systems with privately owned pump stations are excluded from SSES activities. Pump stations 18 and 19 are served by low pressure force main systems.

Additionally, two basins, NN and NN4, have also been excluded from analysis in this report. In both of these basins, the majority of the collection system is owned by the City of Newport News. SSES activities in these basins will be identified by the City of Newport News and conducted by both Newport News and Hampton.

Basins 46, 160, 161, 165, 166, 167, 168 were also excluded from consideration from SSES Activities. There is no population assigned to these basins and there are nominal gravity lines associated with these areas. Basins 46, 160, 161, and 168 have no gravity lines associated with them. Basins 160 and 161 are located inside the Hampton Coliseum building and pump via force main to gravity lines outside the Coliseum. Basin 118 primarily serves the flows from the Coliseum pumps stations which are highly variable and dependent on events occurring at the facility. The pump station located in basin 46 serve private gravity sewer lines. Basins 165, 166, 167, and 168 are small grinder pump stations with low pressure force mains that discharge into gravity sewer. These four stations are located in public parks and carry restroom facilities. The excluded basins are listed in Table 2.7 below:

**Table 2.7: Basins Excluded from SSES Plan**

| Basin | Gravity Sewer (lf) | Exclusion |
|---|---|---|
| 18 | 0 | Low pressure force main |
| 19 | 0 | Low pressure force main |
| 46 | 0 | No population served, nominal gravity sewer only |
| 118 | 2,895 | Receives flows from Coliseum – highly variable |
| 122 | 1,721 | Small pump station, less than 25 gpm |
| 160 | 0 | Located inside Hampton Coliseum. No gravity sewer lines |
| 161 | 0 | Located inside Hampton Coliseum. No gravity sewer lines |
| 165 | 6 | Sandy Bottom Park, No population served |
| 166 | 111 | Sandy Bottom Park, No population served |
| 167 | 124 | Sandy Bottom Park, No population served |
| 168 | 0 | No population served, Nominal gravity sewer lines |
| NN | 9,303 | Hampton only owns small part of basin, SSES activities will be identified by Newport News and conducted by both Newport News and Hampton |
| NN4 | 1,981 | Hampton only owns small part of basin, SSES activities will be identified by Newport News and conducted by both Newport News and Hampton |

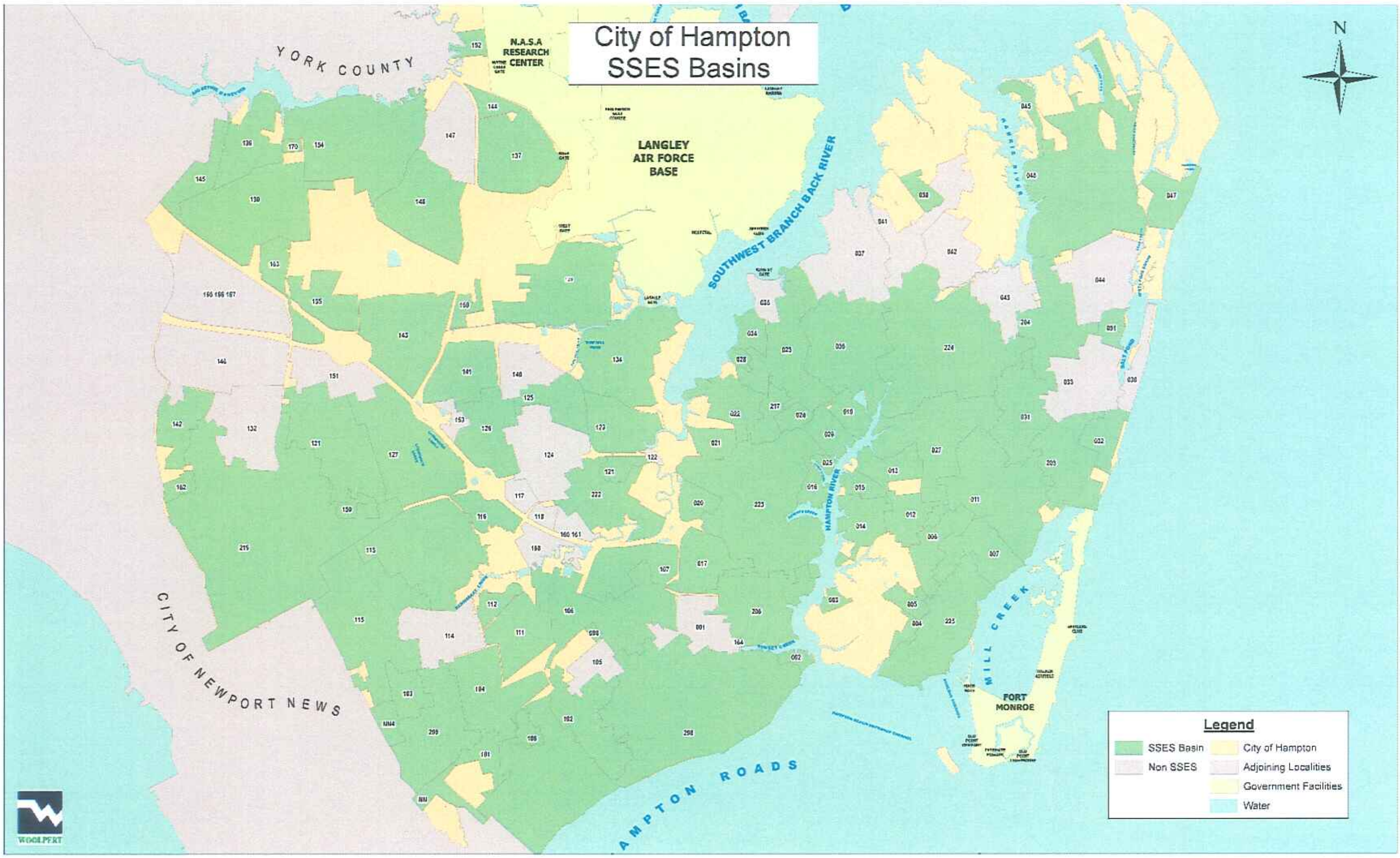
## 2.5 SSES Basins Summary

As indicated in the 2007 Flow Monitoring Plan, the city-owned pump station service areas were grouped into 59 basins for flow monitoring and SSES plan development. The basins were delineated by determining the point where the City's ownership ended and HRSD's began. Everything connected upstream of that point was considered part of the basin. The basins designated in the 2007 Flow Monitoring Plan were reviewed for this SSES Plan and basin numbers were assigned to facilitate the SSES basin identification process. It should be noted that a large portion of Hampton's collection system (31.2 %) is directly connected to HRSD gravity main through hundreds of gravity connections. These connections and the City's gravity sewer upstream have been added to HRSD pump station service areas. This increases the number of basins by the ten HRSD areas. For the development of the SSES plan, the original 59 basins plus the 10 HRSD basins and the 2 Newport News basins were further divided into 114 service areas. For the purposes of this document, these 114 service areas are referred to as basins throughout as indicated on Table 2.8. Table 2.8 also includes an inventory of gravity sewer mains, laterals, manholes, pump stations, and force mains.

The 84 SSES basins identified by this analysis represent approximately 381 miles of the City's 430 miles of gravity sewer collection system.

These basins are shown in Figure 2.4 and listed in Table 2.8 below.

## Figure 2.5 Hampton SSES Basins



# 3.0 SSES Basin Prioritization

In the second step of the evaluation process, the SSES basins that were identified were subjected to additional screening and prioritization process as suggested in the RTS.

The RTS suggests the following minimum criteria be used:

- Number and severity of preventable SSOs
- I/I Volume
- Peak one-hour flow
- Operations and maintenance (O&M) history
- Sewer basin criticality factors

Based upon available data and particulars of Hampton's system, the following criteria was used to prioritize the basins for further study:

- Number of SSOs
- I/I Potential Peak Flow Rate Reduction
- O&M history
- Prior SSES activities
- Physical characteristics
- Sewer Basin criticality

The identified SSES basins were prioritized using the guidelines from the RTS and other available relevant data. A weighted scoring system was used that allows a maximum score of 100 points be obtained based on the criteria listed above. The higher the score obtained, the higher the priority assigned to the SSES basin. The pipe length data for each basin is expressed in terms per inch-diameter-mile calculation or the measured linear feet of gravity sewer pipe in each basin in order to create a unit measurement which facilitates a comparison each basin relative to other basins of a different size. Each criterion has been assigned points based upon its relative importance. The points were multiplied by each basin's relative ranking to calculate a basin's priority score. The results from the prioritization are shown in Appendix E.

## 3.1 Criteria

The following criteria were used to prioritize SSES basins.

### Number of SSOs

The first criterion used was the number of SSOs in a given basin over the past eight years. The City of Hampton provided records of approximately 300 SSOs from October 2000 to July 2008. (The SSOs are shown in Figure 2.3.) These records were reviewed for the type of SSO, weather conditions and their associated basin. However, for the majority of these records, specific types of SSOs were not noted. Addresses were used to identify the basin location of each SSO. Due the extremely low number of wet weather SSOs, dry weather and wet weather SSOs were considered together for this parameter.

Each basin was ranked by the number of SSOs per inch-diameter-mile. The basin with the highest number of SSOs per inch diameter mile was given the highest ranking. This parameter was assigned a maximum potential of 30 points. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

## Inflow/Infiltration Peak Flow Reduction Potential

Inflow and infiltration (I/I) is the component of sewer flow that results from groundwater and precipitation that enters the sewer system. Typically, I/I volume is calculated by comparing dry and wet weather flow volumes. For the purposes of this category, since the 10-year projected peak flow rates were calculated using the SHAPE and EPA – XP SWMM5 programs as detailed in Section 2.2.2, a comparison was made to the peak dry weather flow rate was made for the monitored basin. Basins without flow data were associated to basins with data using the characteristics indicated in Section 2.2. This potential I/I peak flow rate reduction was then divided by inch-diameter-mile to allow this rate be applied to the associated basins.

Each SSES basin was ranked by I/I per inch-diameter mile. The basin with the largest amount of I/I rate per inch-diameter-mile was given the highest ranking. This parameter was assigned a maximum potential of 20 points. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

## Operation & Maintenance Activities

The City utilizes a infrastructure management system (IMS) to keep track of its O&M activities and repairs. Work orders from the previous five years performed on its gravity sewers were analyzed to determine the number of work orders performed on each basin. Each basin was then ranked by the number of work orders per mile of pipe. This establishes a unit rate frequency of O&M activities in each basin. The higher the number of work orders per mile, the higher the basin was ranked. This parameter was assigned a maximum potential of five points. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

In addition, the City's IMS tracks the cost of the repairs performed as well. This criterion is used to establish an order of magnitude on repairs being made. The repair work orders from the previous five years were analyzed to determine the cost of repair per inch diameter mile of pipe basin. This establishes a unit rate cost of O&M activities in each basin. . The higher the cost per inch diameter mile, the higher the basin was ranked. This parameter was assigned a maximum potential of five points. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

Gravity main and manhole rehabilitation costs are also maintained in the City's IMS and were included in the prioritization scoring. The costs for rehabilitation activities were analyzed per basin on a per mile of pipe basis. This establishes a unit rate cost of rehab work already done in each basin. Each basin was ranked by the relative cost of repairs. The higher the repair costs per basin, the lower the basin's relative ranking. In general, the rationale for this method of ranking was that the more money that has been spent in a basin on manhole rehabilitation and gravity main rehabilitation, the less likely that SSES activities will be required in the future. Both the manhole and gravity main parameters were assigned a maximum potential of five points each for a total of ten possible points for this category. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

## Previous SSES Activities

The City has been very proactive with performing SSES activities prior to this SOC. Data was provided by the City on which basins had been subject to prior SSES activities including manhole inspections and CCTV.

Some of the CCTV inspections completed previously did not use the NASSCO Pipeline Assessment Certification Program WinCam Software as required by the RTS but a similar program. After discussion and review by EPA/DEQ, the use of these inspections will be permitted. Additionally, the results from these previous activities will be included in the Condition Assessment Report.

Each basin was categorized as whether these activities had been completed for the entire basin. Basins were ranked based upon percent completion. Figures 3.1 and 3.2, below, show the basins where manhole inspections and CCTV are 100% complete for the entire basin.

Basins with a previous history of SSES activities were ranked higher than basins with no history of SSES activities. Both manhole inspections and CCTV activities were assigned a maximum potential of five points each for a total of ten points in this category. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

**Figure 3.1 Completed Manhole Inspections**

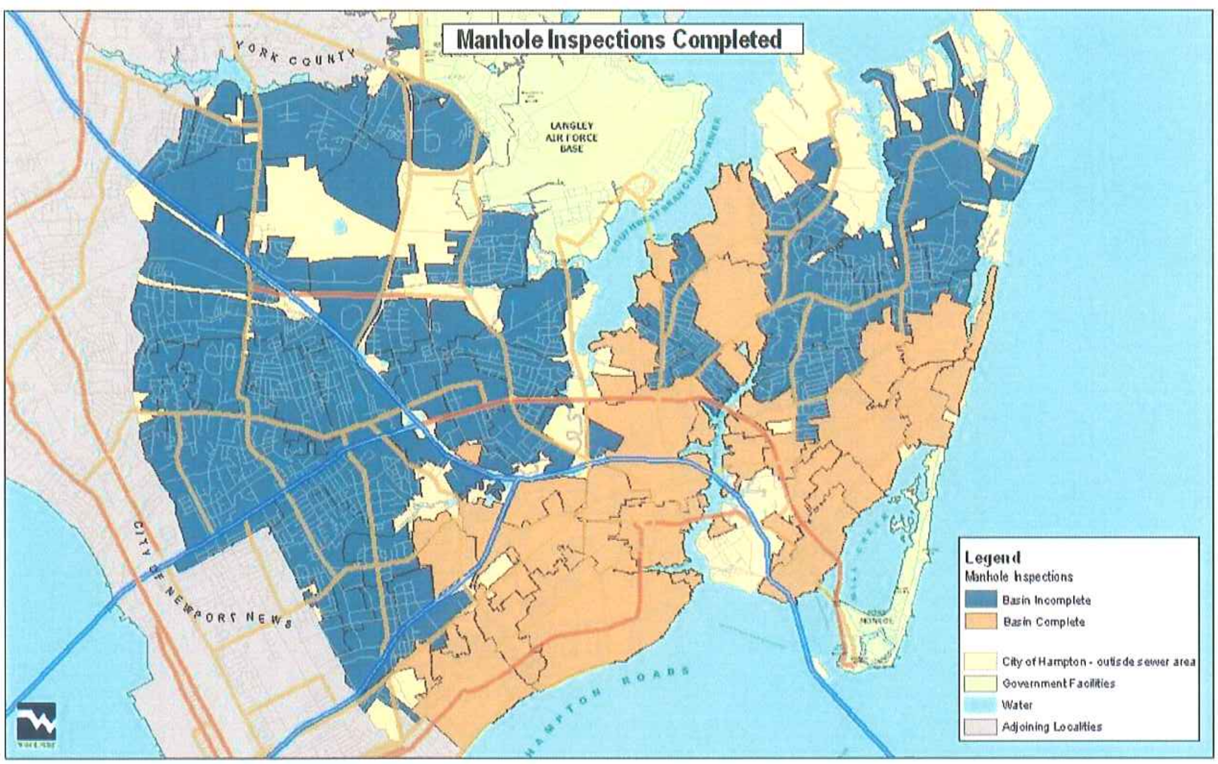


**Figure 3.2 Completed CCTV Inspections**


## Basin Criticality

Sewer basin criticality is identified as a prioritization criteria in the Regional Technical Standards, in order to capture environmental, public health and safety risks. Due to the City being adjacent to the Chesapeake Bay and it tributaries, some SSOs are considered to be potentially more hazardous due to their location in the system. Therefore, basin criticality was evaluated based upon the following factors:

- Proximity to surface waters,
- Proximity to schools, and
- Proximity to parks and playgrounds.

In Virginia, surface waters are rated based upon six designated uses: aquatic life, fish consumption, shell fishing, recreation, public water supply and wildlife. The rivers and estuaries in the Hampton area are considered impaired (waters that do not support their designated uses) in particular with regard to fish consumption and sustaining aquatic life. Therefore, basins adjacent to surface waters are considered critical in relation to both environmental and public health risks.

Schools, parks and playgrounds are areas where the public health could be at risk from exposure to SSOs. Analysis of the data provided shows that 48 of the 116 basins in Hampton's system are adjacent to surface water bodies. Schools are located in 22 basins and parks and playgrounds in 43 basins.

Each basin was assigned one point for each applicable critical factor: proximity to schools, adjacent to surface water bodies, and proximity to parks and playgrounds,. The maximum available score for each basin was 4. The basins were then ranked. The basin criticality parameter was assigned a maximum potential of 15 points. The relative ranking was multiplied by the assigned points to calculate the score for each basin.

### Physical Characteristics

The physical characteristics of gravity sewer systems such as pipe age and material type of pipes can be an indicator of performance problems in the system. Pipe material types usually prove to be inconclusive because of the many variables that impact their performance such workmanship at installation, and joint types. These types of problems are revealed through the O&M history evaluated previously. Pipe age is a similar issue. In this prioritization age is used to give priority to older basins over newer basins with similar issues. However due to many of the issues being evaluated previously, this criteria was only assigned maximum potential of five points.

The average age of pipes in a basin was determined by data provided by the City and is listed by the approximate decade the pipe was installed. Basins with older pipes were ranked higher than those of newer construction.

## 3.2 Methodology

Once all data was reviewed, each basin was ranked for each parameter. Where appropriate, data was compared on either a linear foot or inch diameter mile comparison to develop a basin's relative ranking. The ranking was then multiplied by the points for the parameter. Then the points were added up for each basin. The basin with the greatest number of points is given the highest priority. The number of points for each criteria is shown in Table 3.1 below.

**Table 3.1 Summary of Prioritization Points Available**

| Criteria | Points Available |
|---|---|
| Number of SSOs per mile | 30 points |
| I/I Volume | 20 points |
| O&M History including rehabilitation | 20 points |
| Previous SSES Activities | 10 points |
| Basin Criticality | 15 points |
| Physical Characteristics | 5 points |

The formula for calculating a basin priority is depicted below:

$$\frac{\begin{array}{l}(\text{SSO rank X SSO points} + \\ \text{I/I rank X I/I points} + \\ \text{O\&M rank X points} + \\ \text{Previous SSES Activities rank X points} + \\ \text{Basin Criticality rank X points} \\ \text{physical characteristics rank X points})\end{array}}{\text{total number of basins}} = \text{basin priority score}$$

For each of sewer basins, the maximum amount of points available is 100. The worksheet containing the prioritization calculations can be found in Appendix D.

## 3.3 Basin Ranking

The relative ranking for each SSES basin is shown in Table 3.2 below.

**Table 3.2 SSES Basin Ranking**

| Basin ID | Total Score | Ranking | Linear Feet |
|---|---|---|---|
| 203 | 84.82 | 1 | 39,242 |
| 119 | 84.02 | 2 | 19,973 |
| 209 | 81.10 | 3 | 19,208 |
| 20 | 78.48 | 4 | 2,636 |
| 48 | 78.41 | 5 | 30,228 |
| 24 | 77.68 | 6 | 3,299 |
| 121 | 76.77 | 7 | 4,365 |
| 104 | 76.77 | 8 | 15,208 |
| 23 | 73.29 | 9 | 48,424 |
| 134 | 72.74 | 10 | 29,749 |
| 204 | 72.68 | 11 | 26,100 |
| 123 | 72.26 | 12 | 27,951 |
| 131 | 72.26 | 13 | 48,383 |
| 115 | 71.77 | 14 | 70,946 |
| 217 | 70.91 | 15 | 12,959 |
| 127 | 70.85 | 16 | 43,979 |
| 154 | 69.63 | 17 | 32,163 |
| 223 | 69.57 | 18 | 82,458 |
| 206 | 68.84 | 19 | 44,506 |
| 133 | 68.41 | 20 | 42,081 |
| 26 | 68.29 | 21 | 11,208 |
| 113 | 66.16 | 22 | 67,771 |
| 141 | 65.85 | 23 | 17,523 |
| 14 | 64.15 | 24 | 16,460 |
| 11 | 63.96 | 25 | 68,267 |
| 225 | 63.66 | 26 | 49,644 |
| 22 | 62.99 | 27 | 24,029 |
| 36 | 62.80 | 28 | 52,041 |
| 12 | 62.56 | 29 | 16,685 |
| 208 | 62.26 | 30 | 227,040 |
| 27 | 61.83 | 31 | 60,667 |
| 224 | 61.83 | 32 | 86,259 |
| 15 | 61.40 | 33 | 5,734 |
| 126 | 61.22 | 34 | 8,826 |
| 6 | 60.85 | 35 | 15,866 |
| 5 | 60.43 | 36 | 7,681 |
| 102 | 60.30 | 37 | 42,697 |
| 219 | 59.94 | 38 | 145,960 |
| 3 | 59.88 | 39 | 4,030 |
| 125 | 59.76 | 40 | 9,953 |
| 21 | 59.70 | 41 | 12,101 |

| Basin ID | Total Score | Ranking | Linear Feet |
|---|---|---|---|
| 135 | 56.89 | 41 | 11,797 |
| 136 | 56.77 | 43 | 20,779 |
| 17 | 55.24 | 44 | 5,506 |
| 31 | 55.18 | 45 | 45,512 |
| 47 | 55.00 | 46 | 14,293 |
| 152 | 52.74 | 47 | 3,761 |
| 143 | 50.85 | 48 | 12,007 |
| 103 | 50.73 | 49 | 4,060 |
| 137 | 50.12 | 50 | 23,371 |
| 32 | 49.76 | 51 | 17,897 |
| 7 | 49.70 | 52 | 23,895 |
| 106 | 47.80 | 53 | 36,614 |
| 159 | 46.46 | 54 | 7,421 |
| 164 | 45.43 | 55 | 191 |
| 145 | 43.66 | 56 | 16,599 |
| 101 | 43.29 | 57 | 9,542 |
| 2 | 43.05 | 58 | 1,341 |
| 130 | 42.99 | 59 | 10,193 |
| 51 | 42.44 | 60 | 3,042 |
| 150 | 41.95 | 61 | 1,223 |
| 45 | 41.65 | 62 | 1,962 |
| 10 | 41.40 | 63 | 7,322 |
| 107 | 41.28 | 64 | 14,664 |
| 170 | 40.43 | 65 | 1,738 |
| 34 | 40.37 | 66 | 5,886 |
| 38 | 40.00 | 67 | 2,130 |
| 28 | 39.63 | 68 | 1,732 |
| 13 | 39.09 | 69 | 13,194 |
| 163 | 37.83 | 70 | 3,200 |
| 16 | 36.89 | 71 | 4,972 |
| 162 | 36.59 | 72 | 4,156 |
| 144 | 36.46 | 73 | 1,636 |
| 148 | 36.34 | 74 | 6,418 |
| 116 | 36.28 | 75 | 5,683 |
| 142 | 35.79 | 76 | 18,226 |
| 25 | 32.87 | 77 | 1,057 |
| 112 | 32.80 | 78 | 3,532 |
| 100 | 30.67 | 79 | 10,139 |
| 98 | 29.33 | 80 | 1,800 |
| 4 | 27.32 | 81 | 6,055 |
| 111 | 15.91 | 82 | 23,763 |

# 4.0 SSES PLAN IMPLEMENTATION

Implementation of the SSES Plan will be done in accordance to the RTS Section 5 which states: "A minimum investigative program in all SSES Basins shall include pump station evaluation, manhole checks, and determination of critical inspection areas." Included in the evaluation of pump stations will be an assessment of force mains to determine if a history of failures is present that warrants further field investigations.

The City of Hampton met with the City of Newport News to discuss the shared SSES basins and delineated which locality would perform SSES investigation work required by the RTS. These investigations are identified in this Plan and will be coordinated with the City of Newport News' plan. Gravity sewers located in the City of Hampton served by HRSD pump stations located in SSES Basins will be evaluated by the City of Hampton and the pump stations and force mains will be evaluated by HRSD.

## 4.1 SSES Investigations

For all SSES basins, a condition assessment approach compliant with the RTS will be conducted. All SSES investigations as part of that condition assessment approach will be performed in accordance to Section 4 of the RTS. In scheduling investigations, no distinction has been made between monitored basins and associated basins. The City of Hampton has chosen to perform CCTV inspections and manhole inspections on all basins that exhibited wet weather flows in excess of the peak flow threshold either directly or via basin association. The CCTV inspections will be performed in lieu of smoke testing as outlined in the May 8, 2009 letter from DEQ. CCTV provides a more thorough investigation and this will allow Hampton to maintain consistency with the previously completed SSES investigations. Pump station evaluations will be conducted for all SSES basins. Additional smoke testing and dye flood tests will be performed as necessary to further define I/I defects in the system. All pump stations and force mains associated with SSES basins will be investigated in accordance with the RTS.

### 4.1.1 CCTV Investigation

CCTV inspections will be conducted and recorded in accordance with NASSCO PACP standards and section 4.4.1.2 of the RTS. CCTV investigations will be performed in all SSES basins where RTS compliant investigations have not been conducted in the past 5 years. Previous CCTV investigations have substantially met the RTS requirements and will be included in the Condition Assessment Report.

### 4.1.2 Manhole Inspections

Manhole inspections will be conducted from the surface of all accessible manholes. Inaccessible manholes will be inspected, where possible, by CCTV during upstream and downstream sewer pipe inspections. Manhole inspections will be conducted in all SSES basins where the wet weather flow exceeded the peak flow threshold and where RTS compliant inspections have not been conducted in the past 5 years. All new inspections will be conducted in accordance with NASSCO standards and Section 4.4.1.1 of the RTS. Previous manhole inspections have substantially met the RTS requirements and will be included in the Condition Assessment Report.

### 4.1.3 Pump Station Evaluation

All pump stations within the SSES Basins will be inspected for structural conditions, capacity problems and maintenance issues which may negatively impact performance. The evaluation will include comparing the peak flow threshold of the pump station basin to the corresponding pump station capacity. A standard inspection procedure and form will be developed in accordance with Section 4.4.2 of the RTS.

### 4.1.4 Assessment of Force Mains

Force main routes, air vents, and aerial line crossings of streams and ditches will be visually inspected for signs of leakage or failures, debris accumulation, erosion of soil around pipe and supports and support condition. Force mains will also be evaluated by a review of existing information regarding failure history in accordance with Section 4.4.3 of the RTS.

### 4.1.5 Smoke Testing

Smoke testing will be conducted on an as needed basis after CCTV inspections are completed in SSES basins that exhibit wet weather flows in excess of the peak flow threshold. Testing will be carried out in conformance with EPA Handbook 625/6-91-030, Section 4.3.6 and WEF Manual of Practice FD-6. The location of smoke leaks will be marked, digitally noted and photographed for inclusion into the City's GBA System.

### 4.1.6 Dye Testing

Dye testing may be used to complement smoke testing to verify the sources of I/I as necessary or if CCTV investigation is inconclusive. This procedure is more further defined in Section 4.4.1.4 of the RTS.

### 4.1.7 Night Flow Isolation

This procedure may be used to trace sources and quantify amounts of infiltration if necessary and is further defined in Section 4.4.1.5 of the RTS.

### 4.1.8 Private Property Inflow and Infiltration (I/I) Abatement Program

Hampton will continue its participation in the Regional effort to develop and adopt a private property I/I abatement program. HRSD and the Localities are collaboratively developing a Private Property I/I Abatement Program that will address I/I issues that originate on private property. This program is important to effective reduction of peak flows related to I/I. Development of this program will require time and resources and there are multiple approaches to address these issues. Significant and difficult challenges exist in development and implementation of this program including, but not limited to, right of access issues, enforcement powers, use of public funds on private property, timing of requirements, impacts to private property owners, defining who will pay for the abatement activities and legal authority to implement the program. Significant work has been performed in Virginia and elsewhere on these issues that will be used to craft the program. It is expected that the program will have regional elements and some customized local elements to reflect differences in HRSD and localities' structure and legal authority. Because of the complexities and the need for some level of regional consensus, it is expected that the development phase of this program may require 1.5 to 2 years. This would be followed by implementation, which will likely be phased in over some period. The predicted effects of this program on peak flow reduction must be accounted for in the development of the Rehabilitation Plans and in the Regional Wet Weather Management Plan.

### Data Collection

All data collected will be geo-referenced to the basin the SSES investigation work has been performed to continue the GIS based tracking of all activities occurring on the City's collection system. Standardized data collection procedures will be developed so that data will be collected uniformly and stored in the City's GIS and IMS. Data collected will also be stored in the City's current GBA work order system.

### Find and Fix

During the SSES investigations, it is likely that certain assets will be found in a condition that warrants prompt corrective action. As indicated in Section 4.6.1 of the RTS, the conditions that may require prompt corrective action include those that:

- Pose an immediate threat to the environment
- Pose an imminent threat to the health and safety of the public
- Create operational problems that may result in SSOs
- Contribute substantial inflow to the system.

Hampton will develop a Find and Fix approach to address such urgent conditions. Using a Find and Fix approach will allow Hampton to respond in a timely and more cost effective manner. Once failures or deficiencies are found, actions will be taken by maintenance personnel or contractors to correct the problem. A work order will be created and the work will be performed and documented in accordance with the RTS and stored in the City's GBA system. Conditions that are found to be less urgent will be included in the Rehabilitation Plan for future repair.

Types of repairs that are typical considered for Find and Fix programs are listed in the RTS include:

- Manhole reconstruction
- Pipeline reconstruction
- Point repairs and section liners
- Cured-in-place lining, slip lining and pipe bursting
- Manhole lining.

### Documentation/Condition Assessment Report

The documentation of all field investigations results, findings and conclusions will be included in the Condition Assessment Report. All rehabilitation results and recommendations from previous SSES activities referenced in this report will also be included in the Condition Assessment Report. The Condition Assessment Report is the basis of the Rehabilitation Plan. All condition assessment documentation will also be submitted with the Rehabilitation Plan.

### Rehabilitation Plan Submittal

The RTS indicates the Rehabilitation Plan must be submitted 47 months (62 months less the 15 months from effective date of the SOC) after submittal of the SSES plan. In order to allow time for the completion of the Rehabilitation Plan activities, it is recommended that the SSES Plan be completed with in 36 months after submittal of the SSES Plan. Based on the May 2009 deadline for submitting the SSES Plan, the SSES investigations will need to be completed by November 26, 2011 and DEQ notified of the competed activities by December 26, 2011. Additionally, the Flow Evaluation Plan needs to be submitted by May 26, 2009.

## 4.2 SSES Plan Schedule

The proposed schedule for the SSES Plan is based on meeting the 2011 completion date and is depicted in the table below. Basins NN and NN4 were evaluated by Newport News and identified as SSES Basins. Hampton will perform smoke testing, manhole inspections, CCTV and dye floods on those lines within the Newport News basins that fall within their service area. Pump station and force main evaluations will be conducted by Newport News. Basins NN and NN4 were ranked high priority by the Newport News SSES plan and are therefore included in the first year of Hampton's scheduled SSES activities.

# Appendix A

# Large Maps

# Appendix B

# Locality Overflow Point Letter

# Appendix C

# Peak One Hour Threshold

# Appendix D

# SSES Basin Prioritization

# Appendix E

# Response to DEQ Comments